SANTA CRUZ ISLAND PRIMARY RESTORATION PLAN

CHAPTER ONE
PURPOSE AND NEED

Introduction

The National Park Service (NPS) and The Nature Conservancy (TNC) have long considered the most critical management actions needed to achieve primary restoration of Santa Cruz Island to be: a) eradicate feral sheep, b) eradicate feral pigs, and c) control fennel. Approximately 35,000 feral sheep were eradicated from TNC property during 1981-87. In 2000 the National Park Service concluded an intensive 3-year effort to remove sheep from east Santa Cruz Island. This effort successfully removed approximately 9,270 sheep from the island. At publishing time of this document it is believed that Santa Cruz Island is sheep-free; however, vigilant monitoring for remaining sheep is on going. Substantial and unaided recovery of native vegetation communities is occurring following removal of sheep from TNC property. However, many native habitats and species continue to be severely impacted by feral pigs, fennel, and other non-native plant species.

The presence of feral pigs greatly facilitates the spread of fennel and other invasive weeds. Pig rooting causes massive destruction of native species and leaves bare ground that can be easily colonized by weeds. The removal of non-native pigs would greatly reduce the spread of non-native plants and result in substantial natural recovery of native island resources.

Ownership

The ownership of Santa Cruz Island is divided between the NPS and TNC. NPS owns the eastern 24% of the island (ESCI); TNC owns the western 76% of the island (C/WSCI). (Figure 1).

All of Santa Cruz Island is within the boundaries of Channel Islands National Park, since the Park's establishment in 1980 (Figure 2). The Park's enabling legislation recognizes the value and appropriateness of achieving park goals through projects anywhere on the island and authorizes the use of federal funds on privately held portions of the park in order to protect and restore valuable resources.

The NPS and TNC share similar mandates for the conservation and protection of natural resources. The mission of Channel Islands National Park is to protect the nationally significant natural, cultural, scientific, and scenic values of the Channel Islands and adjacent marine waters and to provide present

and future generations appropriate opportunities to experience and understand park resources. The Nature Conservancy, a private non-profit conservation organization, is committed to preserving sustainable ecosystems that maintain and enhance native biological diversity (The California Nature Conservancy 1997).

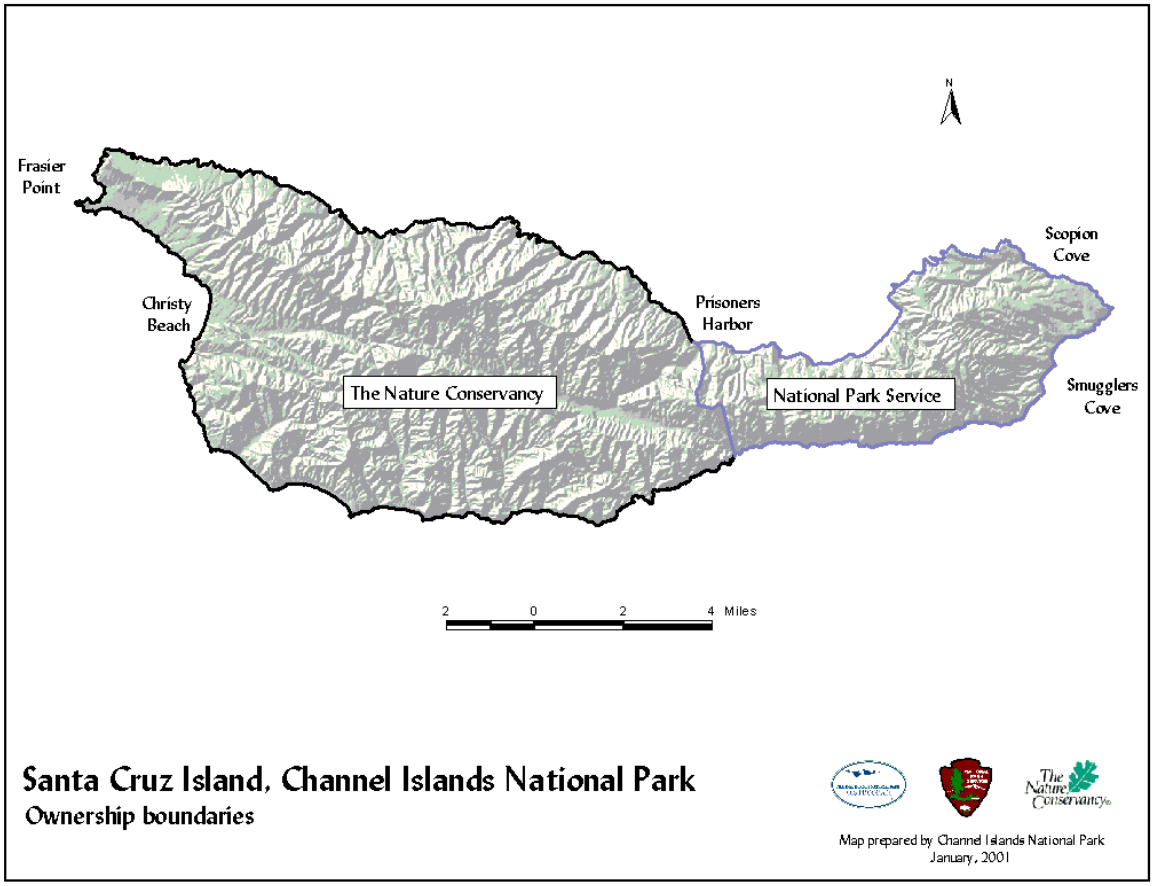
Guidance and Authority for Resource Management

The 1916 NPS Organic Act, (16 USC 1 et seq.) directed that NPS lands be managed to conserve the resources contained within "in such manner and by such means as will leave them unimpaired for the enjoyment of future generations." The Redwoods Act of 1978 (16 USC 1a-1) reaffirmed this principle. In general, these two statutes confer upon the Secretary of the Interior the discretion to determine how best to protect and preserve park resources.

Since the establishment of Yellowstone National Park in 1872 and the subsequent formation of the National Park Service in 1916, the philosophy of natural resources management has evolved. Simple concepts such as protection of wildlife from poaching gradually gave way to recognition of the complexities of comprehensive ecosystem management in a regional and global context (NPCA 1989).

In 1961, the Secretary of the Interior convened a blue-ribbon panel to evaluate how NPS should manage large mammals and other animals. The resultant report (Leopold et al. 1963) clearly directed NPS toward *ecosystem management*, which is the management of all components of an ecosystem as a whole, rather than single species management. The Leopold Commission promoted the concept that national parks should be managed as "vignettes of

Figure 1: Santa Cruz Island Ownership Boundaries



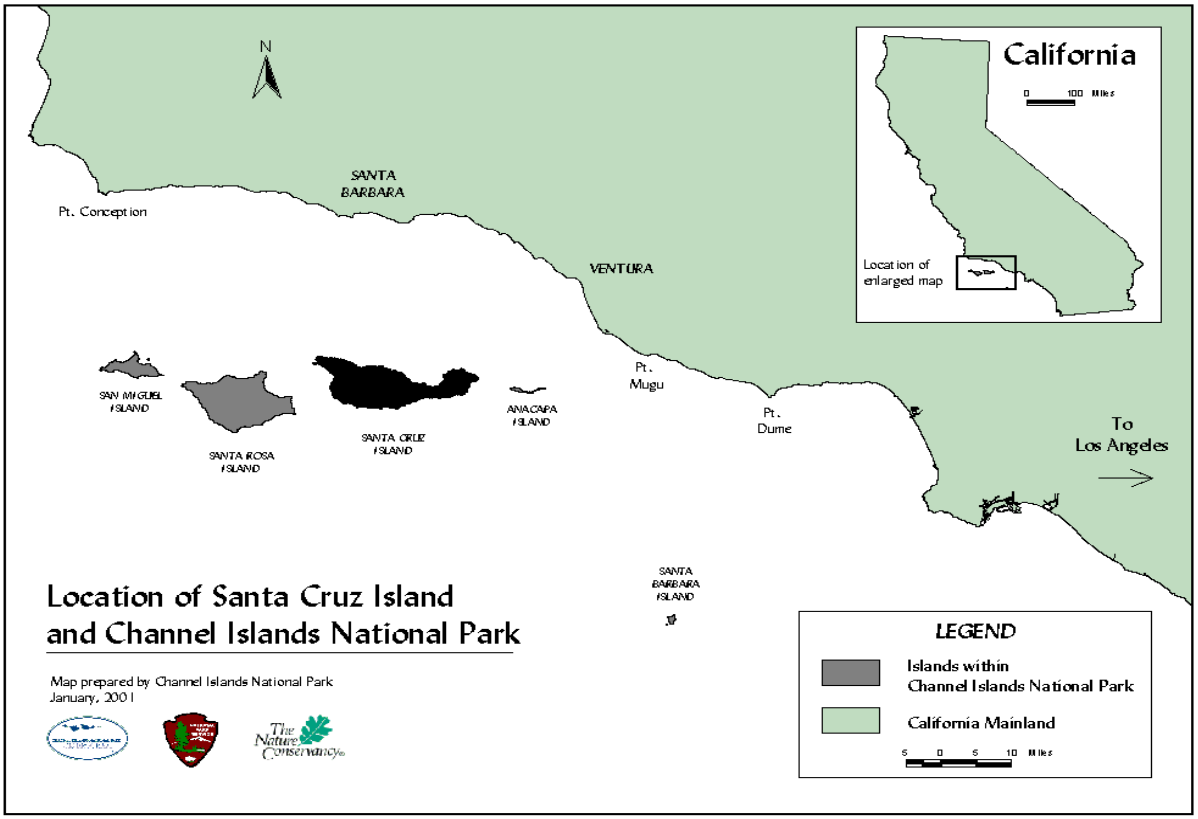
primitive America" in order to preserve, to the extent possible, the biota that existed or would have evolved had European humans not colonized North America. Although this has been interpreted by some as a call for "hands-off" management of a static primitive condition or scene, the Leopold Commission actually promoted an aggressive stewardship of parklands with "hands-on" management techniques, and perpetuation of dynamic, evolving ecosystems. For example, the report called for restoration of natural fire regimes in parks.

More recent work has built upon the findings of the Leopold Commission regarding resource management in NPS parks. Parsons et al. (1986) states that the principal aim of National Park Service resource management in natural areas is the unimpeded interaction of native ecosystem processes and structural elements. Parks should protect not only structural elements such as plants, animals, soil, water, and air, but also dynamic ecosystem processes such as natural fire, biotic evolution, and nutrient cycling.

In 1989, NPS again convened a blue-ribbon panel to assess the role of resource management and research in the future of national parks. The resulting report (NPCA 1989) validated findings of the Leopold Commission, affirming that the focus of park management should be to maintain or restore native biota and ecosystems and to resist establishment of alien, non-native organisms. Where possible, ecosystem management should attempt to preserve natural processes operating at a scale consistent with the evolution of the ecosystem being managed. The report recommended that NPS move well beyond static scene management to provide stewardship for the elements and processes contained in parks.

National Park Service management policies (NPS 2000) also reflect the development of ecosystem management concepts. In part, the policies state that natural resources should be managed with a concern for fundamental ecological processes as well as for individual

Figure 2: Vicinity Map Santa Cruz Island



species and features:

Managers and resource specialists will not attempt solely to preserve individual species (except threatened or endangered species) or individual natural processes; rather they will try to maintain all the components and processes of naturally evolving park ecosystems, including the natural abundance, diversity and ecological integrity of the plants and animals (NPS 2000).

Guidelines for management of species federally listed as threatened, endangered or candidates for listing are found in NPS management policies and natural resources management guidelines. National Park Service management policies (NPS 2000) and guidelines for natural resources management (1991) establish the responsibility of NPS, and the individual park, for managing both listed and candidate species. They also stress that management actions should emphasize removal of threats, but also include active recovery efforts, and that management should be done in an ecosystem context.

The Channel Islands National Park General Management Plan (1980,1985) identified the need to remove exotic animals from Santa Cruz Island.

The Endangered Species Act requires that actions authorized, funded, or carried out by federal agencies not jeopardize the continued existence of listed species. Under section 7(a)(2) of the ESA (16 USC section 1536), federal agencies are required to consult with the U.S. Fish and Wildlife Service (USFWS) on actions which may affect listed species or critical habitat. Because this Primary Restoration Plan proposes actions that could affect the 9 federally listed plant species and one proposed species on Santa Cruz Island, NPS will consult with USFWS on likely effects to those species.

National Park Service management also seeks to preserve and foster appreciation of cultural resources in NPS' custody through appropriate programs of research, treatment, protection, and interpretation (NPS 2000). Guidance for cultural resources management in NPS units is found in National Park Service Management Policies (2000) and Cultural Resource Management Guidelines (NPS-28). Management of cultural resources in NPS units is subject to the provisions of the National Historic Preservation Act (16 USC 470 et seq.), the National Environmental Policy Act (42 USC 4371 et seq.), the American Indian Religious Freedom Act (42 USC 1996), the Advisory Council on Historic Preservation's regulation regarding "Protection of Historic Properties" (36 CFR 800), the Secretary of the Interior's "Standards and Guidelines for Archeology and Historic Preservation (FR 48:44716-40) and "Federal Agency Responsibilities under Section 110 of the National Historic Preservation Act" (FR 53:4727-46).

Purpose and Need

Purpose

The purpose of the Santa Cruz Island Primary Restoration Plan is to protect the unique natural and cultural resources of the island from continued degradation and to initiate recovery of the island ecosystem by:

- Eradicating feral pigs island-wide
- Controlling fennel

Other actions are being done to restore and protect sensitive resources on Santa Cruz Island. These efforts include bald eagle re-introduction, island fox captive breeding, and golden eagle removal. These actions are ongoing and are not addressed in detail in this document. The NPS believes that the eradication of pigs is crucial for the success of these programs. These actions are discussed in greater detail in Chapter Four – Past, Present, Future Actions.

Need for Action

These actions are necessary in order to:

- Protect and initiate restoration of native plant communities
- Protect rare plant species
- Control and reduce the spread of invasive, non-native weeds, such as fennel, *Foeniculum vulgar*e.
- Protect island foxes through removal of the non-native food source (feral pigs) supporting non-native golden eagles
- Conserve archeological sites threatened by accelerated erosion and pig rooting
- Initiate conservation and restoration of soil resources

Invasions by non-native plant and animal species are generally considered to be one of the greatest threats to global biological diversity (Shafer 1990, Soule 1990). These invasions have been described as a "biological wildfire" (Federal Interagency Committee for the Management of Noxious and Exotic Weeds, 1998). Many examples exist demonstrating the negative impacts of non-native animals and plants on native biota. At the population level, native species can undergo a reduction in recruitment, distribution and abundance (Vitousek 1990), or be driven to extinction (Savidge 1987). At the community level, invasions can radically alter the structure and composition of native plant and animal communities (MacDonald and Frame 1988), and at the ecosystem level they can alter nutrient cycles, fire regimes, and other processes (D'Antonio and Vitousek 1992, Singer et al. 1984).

Ranchers and previous landowners of Santa Cruz Island have tried unsuccessfully to eradicate pigs since their introduction almost 150 years ago. Marla Daley, an expert on Santa Cruz Island history, reported (1999) that multiple efforts to eradicate feral pigs have been undertaken by previous landowners using such varied methods as roping, spearing, and the release of a swine disease, hog cholera. In addition, island scientists have unanimously called for the eradication of feral pigs at the earliest possible date (Brumbaugh 1980, Van Vuren 1981a, Van Vuren 1981b, Hochberg et al. 1980, Baber 1982, Laughrin 1982, Collins 1987, Arnold 1999, Glassow 1999) due to documented impacts to natural and cultural resources. Institutions, agencies, and individuals with long-term associations with Santa Cruz Island have indicated their support for the need of a feral pig eradication program (Coblentz 1988, Ehorn 1988, Laughrin 1988, Power 1988, Van Vuren 1988, Young 1988).

Restoration of Native Plant Communities

The Channel Islands of California are vivid examples of the pervasive impacts that non-native species can have on ecosystems. The most severe impacts to the islands have been due to exotic animals, especially cattle, feral sheep, goats, and pigs (Brumbaugh et al. 1980, Minnich 1980). In addition to the impacts from feral and domestic livestock, many species of non-native plants have become established, affecting all of the island's vegetation communities, and dominating some the island's plant communities. Non-native plants now comprise between 20-48% of the species on the islands, and between 25-80% of the ground cover (Halvorson 1992, Junak et al. 1995, and Klinger in prep).

Although to some degree non-native species, particularly plants, would remain established on Santa Cruz Island. However, it is the Park's goal to eradicate non-native species where feasible, and if not, reduce them so that they are a minor component of the island environment. There are some non-native species that cause such significant impacts to other species (feral pigs and fennel are examples) that it is imperative to eliminate or significantly control their numbers and extent in order to protect significant park resources. Fennel is the highest priority for control because

its' dense thickets are expanding rapidly, inhibit native communities from becoming established, and interfere with the eradication of feral pigs. Feral pigs significantly inhibit the regeneration of oaks, and their disturbance causes conditions that favor establishment of non-native species over native species.

Protection of Listed Plant Species

In 1997 the U.S. Fish and Wildlife Service (USFWS) listed nine plant species on Santa Cruz Island as threatened or endangered. Rooting and grazing by feral pigs was a factor in the decline of each of these species. The Recovery Plan for Thirteen Plant Taxa from the Northern Channel Islands (USFWS 2000) recommends development and implementation of an island-wide pig removal plan. The recovery plan states that the highest priority for protecting existing T&E populations on Santa Cruz Island is to remove pigs. Specifically the recovery plan states… "to prevent the continuing habitat degradation on Santa Cruz Island. The National Park Service should collaborate with The Nature Conservancy and other California Island managers to develop methods that will expedite the elimination of pigs from all of Santa Cruz Island."

Many resource scientists, including a group of 20 land management professionals convened on SCI in 1998, have made similar individual recommendations.

Reduce Spread of Non-native Weeds

The spread of many non-native weed species, such as fennel, is greatly facilitated by the transport of their seeds by animals and the presence of bare, unvegetated ground easily colonized by weeds. Feral pigs spread non-native weeds through two basic mechanisms. Pigs feed on the seed heads of annual exotic grasses, fennel, and other undesirable plants. The seeds emerge from the pig's digestive system intact and able to sprout. Pigs also carry seeds in their coats, having the ability to transport seeds many miles from the source point. Furthermore, the rooting of pigs removes vegetative cover and creates bare ground for establishment of weedy plants.

Protection of the Island Fox

The island fox (*Urocyon littoralis*) is endemic to the California Channel Islands. The fox exists as a different subspecies on each of the six islands (Wayne et al. 1991, Collins 1993). It is distributed as six island populations varying in size from less than a hundred to a few thousand individuals. Due in part to its limited distribution and small numbers, the island fox has been listed as a threatened species in California (California Department of Fish and Game 1987) and is proposed for listing as a federally endangered species.

The island fox population on San Miguel has declined sharply from levels measured in 1993 (Coonan et al. 1998, 2000) with the adult population falling from 450 in 1994 to 15 in 1999 (Coonan et al., in prep). Monitoring data from Santa Cruz Island and survey data from Santa Rosa Island indicate that island foxes are undergoing similar catastrophic declines on those islands as well.

The catastrophic decline of island foxes appears to be due to predation by non-native golden eagles (Roemer et al. 2001a). The primary year-round food source that sustains the golden eagles is the piglets produced on Santa Cruz Island. The park is currently capturing and removing golden eagles from the northern islands. However, until the food source provided by piglets is removed, golden eagles would continuously re-establish populations on the island and prey on island foxes.

Protection of Archeological Sites

Santa Cruz Island contains a rich archeological record of the Chumash culture

contained in some 3,000 sites, with the earliest dating nearly 9,000 years ago. Sites range from isolated artifacts to huge, stratified sites spanning a period of 8,000-9,000 years. The large number, diversity and relatively undisturbed nature of the island sites provide excellent research opportunities for archeological investigations into human adaptation in a context of changing environments and cultural conditions. Ninety percent of the island is listed in the National Register of Historic Places for its archeological significance. The remaining ten- percent of the island is eligible for listing in an expanded archeological district.

Feral pig rooting has damaged a large number of the island sites. Pig rooting to a depth of three feet has been noted in a number of sites. The information potential of some shallow sites and surface scatters has been completely destroyed by pig rooting. Rooting in the upper layers of deeper, more complex, stratified sites profoundly disturbs time and spatial relationships and destroys the context of the information contained in these sites. In addition, pig rooting has disturbed prehistoric and historic period burials found in many locations on the island. Continued pig rooting of archeological sites on the island would result in their loss of integrity, and ultimately loss of the values which make the Santa Cruz Island archeological district eligible for inclusion in the National Register of Historic Places.

Conservation of Soils

The long history of grazing by non-native ungulates has greatly accelerated erosion of soils on Santa Cruz Island. Large areas have been denuded of vegetation and are eroded down to bedrock. Rooting by pigs exposes substantial sections of land to erosion by water and wind. Erosion and rooting cause disturbance to archeological sites that have long been protected by vegetation (Glassow and Arnold, pers. comm. 1999).

Scope of the Proposed Action

This document focuses on the concrete and immediate steps that must be taken to reverse the environmental degradation of Santa Cruz Island caused by feral pigs. The scope of the proposed action is to fully eradicate feral pigs from SCI and to implement significant fennel control measures. These two actions have been determined to be the two most important actions that can be implemented in order to abate on-going resource degradation and recover unique island resources.

The restoration actions proposed in this document will require a major commitment of resources. It is recognized that additional intervention would be required in the future to ensure the full protection and recovery of island resources. Additional restoration efforts including island fox captive breeding, bald eagle restoration, and golden eagle removal are currently ongoing. The implementation of these activities is not reliant on the completion of this environmental analysis. However, the environmental effects of implementing these activities have been included, where appropriate, in the cumulative effects analysis in Chapter Four.

This environmental analysis will result in a record of decision encompassing feral pig eradication and fennel control, and their associated activities. Other proposed or ongoing restoration/protection activities (such as those mentioned above) may be related or may benefit from the SCIPRP project; however, implementing these projects would require separate analysis and separate decisions.

Decisions to be Made

The official responsible for choosing the management actions for this restoration project is the National Park Service Pacific West Regional Director. Upon completion of the environmental analysis, the Regional Director can decide to:

- Select one of the alternatives analyzed within the Final EIS, including the No-Action alternative; or,
- Modify an alternative (for example, combine parts of different alternatives), as long as the environmental consequences of the modified action have been analyzed within the Final EIS.

Factors the Regional Director will take into consideration in making a decision are:

- Does the alternative meet National Park Service guidelines and policies, including the Park's General Management Plan?
- How well does the alternative meet the "Purpose and Need" for this project?
- How does the alternative respond to and/or resolve the environmental issues raised for this project?
- The nature and extent of public comment to the environmental analysis.

SANTA CRUZ ISLAND PRIMARY RESTORATION PLAN

CHAPTER TWO
ALTERNATIVES

Introduction

This chapter describes the four alternatives to be considered for implementation and identifies the significant environmental issues used to formulate these alternatives. The environmental issues were developed as a result of "scoping" conducted for this analysis. The "scoping" actions that were conducted for this analysis are described in detail in Chapter Five "Consultation and Coordination". This chapter concludes with a section that explains the rationale for dismissing other methods or alternatives from consideration, and a comparison of alternatives.

Alternative Development Process

Section 102(e) of NEPA states that all Federal agencies shall "study, develop, and describe appropriate alternatives to recommend courses of action in any proposal which involves unresolved conflicts concerning alternative uses of available resources". In addition to responding to unresolved conflicts, an EIS must "rigorously explore and objectively evaluate all reasonable alternatives" [40CFR 1502.14(a)].

Taken together, these requirements determine the range of alternatives and provide the basis for the Deciding Official's informed decision, as required under NEPA. A resource analysis done by NPS and TNC resource management staff in collaboration with pig and fennel control experts resulted in the Proposed Action described in this Chapter. The proposed action identified management actions necessary to eradicate the feral pig population on the island as well as control the non-native fennel that has invaded a large portion of an area known as the isthmus.

Alternatives to the proposed action were developed to focus on the issues identified by resource specialists within the NPS and TNC, pig and fennel control experts, university and academic experts, government regulatory agencies, and the general public. Chapter Five "Consultation and Coordination" lists all individuals, agencies and organizations that provided substantive input regarding the proposed action.

Internal Scoping and Public Involvement Process

The NEPA "scoping" process [40CFR 1501.7] was used to determine the scope of the analysis and to identify potential issues and

opportunities related to the Proposed Action. A complete summary of the scoping and public involvement process for the proposed project is summarized in Chapter Five.

Environmental Issues

Through the Scoping and Public Involvement Process some significant environmental issues were identified. Significant issues are those that may require project-specific alternatives, mitigation measures or design elements to address the potential effects of the proposed activities.

For clarification, a summary statement that defines the scope of the issue for this project will accompany the identified issues. In addition, for each issue, measurement indices are given to provide a preview of how the issue will be evaluated for direct, indirect, and cumulative effects for each alternative. The "Issue" categories are as follows:

- Issue 1: Likelihood of Success
- Issue 2: Impacts to Vegetation, including Weeds and Threatened and Endangered Plant Species
- Issue 3: Impacts to Island Fauna
- Issue 4: Impacts to Physical Resources including Soils, Water and Air Quality
- Issue 5: Impacts to Social Factors including Cultural Resources and Human Use

Issue 1: Likelihood of Success

Efficacy for this analysis is defined as how well the alternative would meet the purpose and need; i.e., how well the alternative would protect the unique natural and cultural resources of Santa Cruz Island by eradicating feral pigs and controlling fennel.

Measurement Index

- Likelihood of achieving island-wide eradication of feral pigs

Issue 2: Impacts to Vegetation, including Weeds and Threatened and Endangered Plant Species

Limited impacts to vegetation would occur as a result of implementing the proposed activities. However, in the long-term, native vegetation would benefit from the eradication of feral pigs and control of fennel. The effects analysis will identify the short-term impacts as well as the expected long-term benefits of implementing the proposed activities.

Measurement Indices

- Health of threatened, endangered, rare, and endemic species
- Extent of fennel
- Extent of other weed species
- Recruitment of island oaks and other woodland species

Issue 3: Impacts to Island Fauna

Introduction of non-native flora and fauna to the Channel Islands has disrupted the ecology on all islands. The largest perturbations to Santa Cruz Island have been the introduction of sheep, pigs, and the highly invasive fennel. Sheep are no longer present on Santa Cruz Island, however abatement of feral pigs and invasive weeds would have a beneficial affect on island fauna. The environmental effects section will focus on native island fauna.

Measurement Indices

- Health of Native Island Fauna
- Non-Native Pigs

Issue 4: Impacts to Physical Resources including Soils, Water and Air Quality

Livestock grazing for over 150 years on Santa Cruz Island has affected soil resources and water quality. The effects analysis will focus on watersheds of Santa Cruz Island and how loss of vegetation cover, direct soil disturbance, and

vegetation type conversion all impact runoff, soil erosion, and stream degradation and aggradation.

The prescribed fennel burn would create smoke that could result in haze and other contaminants being disseminated into the air.

Measurement Indices

- Soil Disturbance and Erosion
- Watershed level impacts
- Landtype and geomorphology (Water Quality)
- Smoke impacts (Air Quality)

Issue 5: Socioeconomic Impacts including Cultural Resources and Human Uses

Cultural resources are non-renewable resources. As such, federal regulations have been passed which prohibit the destruction of significant cultural sites. Significant cultural properties do exist on Santa Cruz Island. The effects analysis will focus on how implementation of each alternative may affect cultural resources on the island.

Visitor use of Santa Cruz Island is different depending on the landowner. Visitor use is accommodated on National Park Service owned lands and is restricted on TNC owned lands. Access by visitors, TNC personnel, park staff, and researchers may be restricted or altered in certain areas during implementation activities.

Measurement Indices

- Prehistoric Cultural Resources
- Historic Cultural Resources
- Human Uses (Human Herbicide Exposure, Visitor Use and Visitation)

Mandatory Topics and Dismissal of Issues

As required under NPS Director's Order 12, this analysis must address twelve mandatory topics. Listed below are topics that must be addressed followed by a discussion on whether they are relevant to the analysis.

a) Conflict with land use plans, policies or controls – The Park's General Management Plan, as well as the Park's Resources Management Plan identified the need to remove pigs from the Santa Cruz Island. The proposed action does not conflict with local, state, or tribal policies or regulations because no plans exist.

b) Energy requirements and conservation potential – Santa Cruz Island, like all of the Northern Channel Islands, does not have electric or gas utilities supplied to it. The Park's administration of these islands always emphasizes energy conservation. For instance all park housing on the island are totally self sufficient for electricity through the use of solar energy. Significant energy demands may be necessary to transport people, equipment, supplies, and to support the operation on the island. Transportation is accomplished mainly by boats owned and operated by the Park.

c) Natural or depletable resource requirements and conservation potential – Resource requirements for this project would be to primarily to supply the operation. Waste of resources is not an issue with operations that occur on the island, as the expense of re-supplying a remote island usually ensures conservation of available resources.

d) Urban quality, historic and cultural resources – Impacts to these resources can be found in Chapter Four - Impacts to Human Uses. Activities associated with the SCIPRP will have a negligible effect on the island's ethnographic resources. Effects on archeological sites, burials, and historic ranching properties have been analyzed in

the "Cultural Resources" section of Chapter Four. Traditional use of the island and its resources for their sacred and heritage values by descendants of the historic owners and inhabitants of the island will be accommodated fully during the course of the project.

e) Socially or economically disadvantaged populations – This proposed project would not change the local population's work, recreation, or social interactions. As such Executive Order 12898 (environmental justice) does not apply to this analysis.

f) Wetlands and floodplains – No development would be occurring in wetlands or floodplains as part of this project.

g) Prime or unique agricultural lands – Santa Cruz Island since the early 1800's has been used for rangeland for domestic livestock. Current ownership emphasizes land use conservation and protection over agricultural use. Since no current agriculture practices are occurring on the island no impacts would occur to agricultural lands. The National Park Service interprets historical land use practices to the visiting public. The alternatives would not interfere with this ongoing interpretive program.

h) Endangered, threatened, or proposed plants and animals – All plant and animal species listed under the Endangered Species Act as threatened or endangered that occur on Santa Cruz Island have been evaluated for impacts (See Chapter Four).

i) Important scientific, archaeological, and other cultural resources, including historic properties listed or eligible for the National Register of Historic Places – Impacts to cultural resources, including an assessment of impacts to properties listed or eligible for the NRHP have been evaluated in Chapter Four – Cultural Resources.

j) Ecologically critical areas, Wild and Scenic Rivers, or other unique natural resources – Although Santa Cruz Island has many unique natural resources, no resources have status as an ecologically critical area, nor are there any Wild and Scenic Rivers on the island. Impacts to unique natural resources can be found throughout Chapter Four.

Wilderness: The legislation establishing Channel Islands National Park requires the National Park Service to determine whether any federally owned parkland is suitable for wilderness designation and should be proposed to Congress for designation. This process has not yet been completed. NPS policies require that, in the interim, no actions be taken which would lessen the suitability of the federally owned lands for wilderness designation.

Achieving the goals of this plan under the proposed action would result in the portion of Santa Cruz Island better attaining the character of wilderness. Specifically, the island ecosystem and processes would be closer to the more natural state that prevailed prior to the introduction of feral pigs and non-native plants. No new permanent structures would be constructed. Temporary structures, such as fences and dog kennels, would be removed at the termination of the project. Mechanized equipment would be used, and is necessary, to achieve the eradication of feral pigs and control of fennel. The actions taken under this project would terminate when monitoring determines that all feral pigs have been eliminated from Santa Cruz Island.

k) Public heath and safety – A number of activities proposed in this analysis have the potential to harm the general public. Because of this potential the Park has proposed that portions of the island be closed to the general public during potentially harmful activities to protect public health and safety. These safety measures can be found in Chapter Four – Human Uses.

l) Sacred sites – The Park's archeologist, in consultation with the Chumash tribe, have not identified any sacred sites on Santa Cruz Island as defined by EO 13007.

Alternatives Considered in Detail

Features Common to Alternatives 2-4

Ecological Monitoring

Monitoring and assessment of key ecosystem components is an action that is included in all alternatives. Pre-eradication surveys for baseline data of pig damage, flora and fauna abundance and distribution would be conducted. Post-eradication surveys of similar components would be conducted in order to measure ecosystem responses to the eradication of feral pigs and control of invasive species, such as fennel.

Fennel Management

Fennel Control

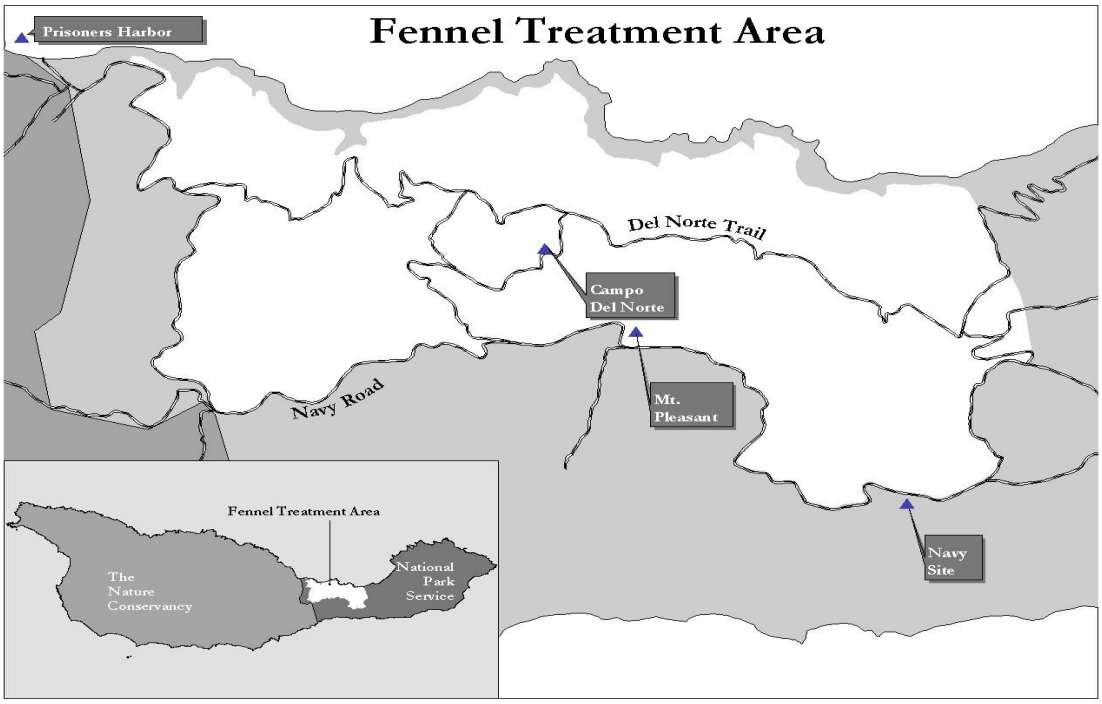
The NPS intends to take action to control invasive plants on Santa Cruz Island regardless of which alternative is chosen. The purpose of weed control is to allow native plant communities to become re-established. If funds become available, the NPS would expand its current efforts to control non-native plants. It is expected that in the long term the extent of the weed problem would be greatest under Alternative One (No Action) and least under Alternatives Two & Four (Eradicate pigs island-wide). NPS weed control efforts would focus primarily on the NPS-owned portion of Santa Cruz Island. However, the NPS plans to continue to work collaboratively with TNC to address island-wide weed problems.

Eradication of all non-native plants from Santa Cruz Island is not reasonably possible. Therefore, our goal is to reduce the density and distribution of non-native species sufficiently that they are a minor and non-dominant member of the island plant communities. The best way to control the spread of non-native plants is to eliminate non-native animals that perpetuate their establishment.

The highest priorities for treatment are highly invasive weeds, outlier populations of weeds, weeds in sensitive habitats, and new introductions. Tools that would be used include digging, mowing, flower/seed head removal, and herbicide treatment. For fennel control the herbicide that would be used is Garlon 3A at a low application rate of 1lb AI/acre. To give optimum wetting and spreading of Garlon 3a a surfactants will be used in the herbicide mix. It is expected that a non-ionic surfactant such as R-11®, methylated seed oil (MSO), or combination thereof would be the surfactants of choice. The use of an MSO's would not effect efficacy (Brenton pers. comm.) of the fennel treatment. The most efficient way to treat the large dense stands of fennel is to use aerial spraying from a helicopter. Aerial application is being considered because it is more effective, accurate, and efficient when applying herbicide over a large, inaccessible area. Aerial herbicide application would require on-board differential GPS to ensure accurate, even coverage in the specified treatment area. Garlon 3A would also be applied using backpack sprayers, ATV spray mounted units, and slip-on spray units mounted in the back of a pickup.

Dense stands of fennel would be the first priority for control. These dense fennel stands are both an impact on native vegetation and hinder feral pig eradication efforts. The Nature Conservancy has demonstrated success with fennel control by burning in the fall/winter of the year and applying Garlon 3A, a selective herbicide, to the stand in the following two

Figure 3. Fennel Treatment Area



springs. This protocol was developed by The Nature Conservancy in an extensive 600-acre program in the Central Valley of Santa Cruz Island.

Additional treatment of fennel in less dense stands and in outlying populations would be required to ensure that native plant communities are not gradually overrun by fennel. The NPS and TNC propose to treat these situations by spot burning where appropriate, followed by herbicidal control.

The prescribed burn would be conducted within the limits of a fire plan and prescription that describe both the acceptable range of weather, moisture, fuel, and fire behavior parameters, and the ignition method needed to achieve the desired effects. The prescribed burn for fennel treatment would be done in the fall/winter of the year, likely using both hand and aerial ignition.

To avoid adverse impacts, full fennel control would be deferred until the fox population has recovered to the point where it could withstand potential direct mortality from a fire (See Chapter Four "Island Fauna").

Fennel Manipulation

The fennel stand (approximately 1,800 acres) that exists on the isthmus of Santa Cruz Island is heavily utilized by pigs. Because of the fennel's density and height within this stand it is thought to comprise excellent cover for pigs. As such, it may compromise pig eradication unless the fennel is manipulated to allow for establishment of walk-in traps, bait stations, and other hunting techniques. Fennel manipulation should not be confused with fennel control. The objective of fennel manipulation is to treat portions of the stand to allow for the successful eradication of pigs within that area.

Fennel manipulation would include mowing, cutting, or flattening the fennel to allow for corridors and other openings for strategic placement of pig walk-in traps and bait stations. Burning the fennel also reduces fennel cover and may be necessary for successful pig eradication on the isthmus. In order to minimize impacts to affected resources, conducting the prescribed burn may require that certain mitigation measures be implemented. These mitigation measures can be found in Chapter Four.

Non-lead Bullet Requirement

The ingestion of lead objects such as shot, bullets, paint chips, mine wastes and fishing sinkers cause considerable harm to migratory birds such as waterfowl and raptors. In raptors, poisoning results from ingesting lead shot embedded in the flesh of prey, such as small ground birds, waterfowl, or from scavenging on large game shot with lead bullets. The lead, once ingested, is ground down in the gizzard or dissolved in the stomach by acids and absorbed into the body as a lead salt, which disrupts normal body functions, especially the digestive and nervous systems. Although this primarily comes from the ingestion of lead directly, certain raptors such as eagles can also die from secondary poisoning, or consumption of birds that have already died from lead poisoning during scavenging.

The Channel Islands is historic habitat for bald eagles, with 25 or more pairs thought to be resident on the northern Channel Islands in historic times. Because of habitat loss, harassment, and DDT poisoning, bald eagles disappeared from the northern Channel Islands by the 1950's. However, recent efforts to reintroduce bald eagles to Santa Catalina Island demonstrate the importance of restoring the avian apex predator to such tightly knit ecosystems as islands. On the northern Channel Islands, the lack of bald eagles acting as the apex avian predator has led to hyper-predation of native endemic island foxes by non-native golden eagles, nearly driving the fox to extinction.

The feasibility of restoring bald eagles to the northern Channel Islands would be studied concurrently with the implementation of the Santa Cruz Primary Restoration Plan. Using funds from the Montrose Chemical Company settlement, a consortium of agencies would begin the five-year study in 2002 with the annual release of 12 eaglets on Santa Cruz Island. Because of the high susceptibility of bald eagles and other raptors to lead poisoning, hunting activities conducted during the SCIPRP would be restricted to the use of non-lead bullets.

Alternatives to lead bullets, such as copper and tungsten bismuth, are widely available and provide accurate trajectory and distance consistent with conventional lead projectiles.

Alternatives Considered in Detail

Alternative One - No Action

Under this alternative NPS would take no action to eradicate feral pigs from Santa Cruz Island or to promote the conservation of rare species, soils, or archeological sites beyond the level of action that the NPS is currently carrying out.

Pigs would continue to occur island-wide and population numbers would fluctuate with environmental conditions. Incidental control of problem animals or focused protection of sensitive resources would occur as staff time and funding permitted.

Weed control would be restricted to current operational levels, which consists of opportunistic removal and spot spraying, but no comprehensive program. Significant fennel control would not be addressed.

There would be no specific mitigation of impacts, since this action would be a simple continuation of current operations.

Monitoring

Monitoring efforts would not change from current NPS levels and would be restricted to measures of community health, listed plant species population health, and vegetation type classifications.

Alternative Two – Simultaneous Island-wide Eradication of Pigs

Under this alternative feral pigs would be eradicated from all of Santa Cruz Island with an intensive, short duration eradication effort.

In November 1998 the NPS and TNC assembled a group of biologists and land managers on Santa Cruz Island to discuss the issue of feral pig impacts and recommended management actions. The individuals determined that eradication of feral pigs should be the highest priority for the management agencies due to the pervasive impacts of pigs on natural and cultural resources. The biologists each felt that an island-wide eradication was an achievable goal.

The National Park Service would contract with professional hunters to eradicate feral pigs under this alternative. Personnel involved in implementing this project would follow the mitigation measures described in Chapter Four for the protection of resources.

The primary tools for pig eradication would be the use of "walk-in" traps and trained hunters with dogs systematically pursuing pigs on the ground. Other techniques such as aerial hunting from a helicopter may be used when appropriate.

During the peak period of the pig eradication program it is estimated that a substantial increase in personnel, dogs, vehicles and ATV's would be on Santa Cruz Island. They would be housed, to the extent possible, in approved government housing on NPS owned property, and in TNC facilities including both Central Valley and West End Facilities. Temporary tent camps may need to be established to facilitate operations in remote areas. Horses may also be used for transportation.

Under Alternative 2 the feral pig eradication project would occur in four phases (see Table 1). The duration and success of each of the phases would depend on a number of factors, primarily: a) level of funding, b) environmental conditions, and c) pig population numbers.

Table 1: Alternative Two Pig Eradication Phases

Phase	Description
I.	*Administration and infrastructure acquisition (Approximately 1 year)*
II.	*Hunting (Approximately 2 years)*
III.	*Final Hunting (Approximately 1 year)*
IV	*Monitoring for Remnant Pigs (Five years)*

Phase I. Administration and Infrastructure Acquisition

This phase would require approximately one year to complete once funding is received and environmental compliance is met. Phase I activities include contracting the services of a professional wildlife management organization that would conduct the pig eradication, and acquiring island infrastructure necessary to conduct the pig eradication operation. Major infrastructure needs include upgrading island housing, establish adequate communication, and define monitoring protocols.

Phase II. Hunting

A simultaneous island-wide operation would require several teams of hunters and dogs repeatedly working sections of the island. Hunters would be on the island for extended periods of time. Each team would have their own transportation, which could include pick-up trucks, "Jeep" type vehicles, ATV's, and/or horses to support their operation.

On Santa Cruz Island, ground hunting with dogs is the best general technique for the eradication program (Klinger pers. comm., Lombardo pers. comm.). Helicopter hunting works well in the wet season and along ridges in

the winter. Use of walk-in traps is successful with high densities of pigs and dense vegetation cover. These could be used in areas with "pig highways", during drought periods, or in fennel stands. Hunting over bait may also be useful in selected situations.

It is expected that the hunting teams would require approximately two years of continuous hunting island-wide to eliminate the pig population on the island.

Phase III: Final hunting

The final hunting phase begins after hunting teams have made at least three visits to all sections of the island and not seen sign or pigs.

During this phase, which would last one year, a reduced number of hunters and dogs would be maintained on the island. At least two people would be dedicated to searching the island to locate pigs or pig sign. Hunters would respond to the location of pig sign to assist the monitoring team. The project would move to Phase IV after the island had no detectable pig sign.

Monitoring for pig sign would continue throughout the life of the project. The primary purpose of the monitoring is to determine the presence or absence of pigs. Water sources, which are preferred habitat for pigs, would be a focus of the monitoring efforts.

Phase IV: Monitoring

This phase would be an intensive period of combing the island to search for pig sign. Hunting teams and dogs would not be maintained on the island any longer. If pig sign is detected, hunters and dogs would be brought to the island once again. Monitoring would continue for five years following eradication of the presumed "last pig" in order to ensure that remnant pigs do not remain. Long term ecological monitoring to assess changes to the ecosystem due to pig eradication would continue into the foreseeable future.

Alternative Three - Eradicate Pigs on NPS Property; Exclude Pigs from Selected Sensitive Resources on TNC Property

Under this alternative the NPS would build and maintain a pig-proof boundary fence approximately 3 miles in length. The fence would require at least two gates at the existing road crossings. Feral pigs would be eradicated from the 14,000-acre eastern portion of the island. It is expected that pigs would regularly re-enter NPS land by going through breaks in the fence, gates left open, or by going around the ends of the fence. To address this NPS would need to have hunters regularly eliminate pigs that enter the NPS land. In addition, NPS would have an ongoing program to maintain the fence, educate staff and visitors about the need to close gates, and to hunt pigs that get through or around the fence.

The eradication of feral pigs from NPS lands would primarily involve NPS personnel and a contractor. Techniques to be used for eradication would be similar to those described in Alternative 2. Trained hunters and dogs systematically pursuing pigs on the ground and walk-in traps would be the primary methods used.

Island surveys for archeological sites and listed plant species are largely incomplete. Surveys by resource experts would need to be conducted and sites selected for protection. These selected sensitive resources would then have pig-proof fence constructed around them and pigs would be excluded from these areas. Known occurrences of federally listed plant populations would be fenced. The most important and threatened archeological sites would also be fenced. However, it is highly likely that some of the resources that fall into the category intended for protection would continue to experience degradation by pigs due to the inability to perform exhaustive inventories. Protective fencing would need to be continuously inspected and repaired to protect

the sensitive resources located within the enclosure.

Additionally, there are many natural or cultural resources of concern that may be rare and/or sensitive but do not have federal protection. These resources would remain vulnerable to impacts by pigs. Fencing all sensitive and/or rare resources on TNC property is beyond the level of what could be funded or maintained over the long term. Therefore, other efforts besides fencing to exclude pigs from selected areas or resources could be implemented.

Alternative Four – Sequential Island-Wide Eradication by Fenced Zone Hunting

Like Alternative Two, this alternative would result in the complete eradication of feral pigs from Santa Cruz Island. In close coordination with The Nature Conservancy, approximately 45 miles of fence would be constructed, thereby splitting the island into 6 distinct management units of about 12,000 acres each (Figure 3). Sequentially, hunting would occur in each of these management units. Complete eradication would be achieved in each of the units in a coordinated effort lasting approximately one year using trained professional hunters using various techniques such as walk-in traps, bait stations, and use of trained hunting dogs. The establishment of fenced zones would allow greater flexibility in the duration of the eradication activities, which is estimated to be approximately six years. Mitigation measures found in Chapter Four would be followed by all personnel involved with the project and would be applied island-wide.

The techniques and tools for achieving the eradication goal would be similar to those described under Alternative Two, and are consistent with other models of eradication such as neighboring Santa Rosa Island, Santa Catalina Island and Hawaii Volcanoes National Park. Trained hunters aided by dogs would seek out and dispatch pigs on the ground. Bait stations and walk-in-traps would be established. Pigs caught in walk-in traps would subsequently be killed. Helicopters may also be used to transport hunters or serve as a hunting platform.

This program would necessitate an increase in on-island personnel, jeep or truck style vehicles, all-terrain vehicles, and the use of hunting dogs. Other methods of transportation might also be used, such as horses or helicopters. Housing would utilize existing structures whenever possible, including government approved facilities on NPS owned property, and TNC facilities including Central Valley facilities, and Christy Ranch. Temporary tent camps might also need to be established to ensure efficient operations in remote areas, such as boat-only accessible anchorages and rough, road-less terrain.

Pig eradication would occur in four distinct phases, all similar to the phases found under Alternative Two. Each phase has discrete requirements for time to completion. Experts have indicated that for the eradication to be successful, hunting must be complete within a ten-year window. Beyond this time eradication would become much more difficult because of vegetation recovery post-sheep grazing. Factors that could influence the duration of the project include but are not limited to: a) committed levels of funding, b) environmental conditions, such as rainfall, and c) pig population numbers. The detailed description of this alternative makes the assumption that sufficient funding would be provided to ensure complete eradication.

Phase I. Administration, Infrastructure, and Acquisition

Spanning approximately one year, this phase would acquire appropriate staff to oversee, manage, direct, and carry out the project including seeking qualified fencing and hunting contractors. Additionally, attention would be given to the infrastructure requirements for project implementation, such as upgrading

Table 2: Alternative Four Pig Eradication Phases

Phase	Description
I.	*Administration and infrastructure acquisition (Approximately 1 year)*
II.	*Fencing (Approximately 2 years, overlapping with Phase III)*
III.	*Hunting (Approximately 6 years, beginning with completion of first fenced zone)*
IV	*Final Hunting and Monitoring (Five years)*

housing facilities to accommodate long-term use, and establishing additional communications on the TNC lands to facilitate a safe and efficient operation. Necessary equipment and supplies would also be secured at this time.

Two TNC facilities would be used to support the operation; bunk cabins in the Central Valley, and the west end Christy Ranch facilities. Upgrades necessary for long-term use at the bunk cabins include: Repair septic tank; expand toilet building to include a waterless urinal & low-flush toilet; replace the hot water tank; upgrade the kitchen cabin including replacing cabinets, shelving, and countertops; and install a 2.5 kW photovoltaic system. Christy Ranch upgrades necessary for long-term use include: install water storage tank near the ranch house; install temporary bunk structures; install a 2.5 kW photovoltaic system.

Phase II. Fencing

Fencing all zones would require approximately 2 years to complete. The island would be fenced off into 6 distinct management units. Five zones average roughly 12,000 acres in size, and one smaller zone (Central Valley Zone) is approximately 3,000 acres. Most pigs are expected to be eradicated within the zones within a one-year time frame, barring factors listed above.

Fences would be constructed of either triple-galvanized steel or special alloy metals to resist corrosion in the heavy marine environment of Santa Cruz Island. Fence construction requires heavy-duty fence posts spaced approximately 8 ft. apart to be pounded into the ground. Mesh wire fence would be strung along the posts, secured to both the posts and the ground. Securing the fence to the ground is vitally important part of the fence construction to ensure pigs cannot get under the fence. Fence integrity is critical to the success of this alternative. This type of fence has been demonstrated to be effective and durable in Hawaii Volcanoes National Park's and Santa Catalina pig eradication efforts.

It is estimated that fencing would be completed across all zones within two years of the start of construction. Hunting and establishing walk-in traps in a zone may begin as soon as the zone fence is completed. Eradication activities may be occurring in one or more zones simultaneously.

Phase III. Hunting

Eradication activities would begin shortly after the first pig zone is complete. The fencing of hunting zones would be completed in the same sequential order that the eradication activities would follow. This would allow for eradication activities to occur in one or more zones at the same time during the first two years of the operation. While fence construction is occurring, eradication activities and fencing activities would be occurring concurrently.

Generally, techniques such as walk-in traps and bait stations, as well as ground hunting with dogs have been shown to have the highest efficiency rate for eradication on SCI (Sterner, 1990). Following that model, to increase efficiency, establishing walk-in traps and bait stations could precede fence completion and ground hunting in each of the zones.

Hunting by zones would require teams of hunters and dogs repeatedly working a zone. Hunters would be on the island for extended periods of time. Each team would have their own transportation, which could include pick-up trucks, "Jeep" type vehicles, ATV's, and/or horses to support their operation.

The sequential order of fencing and hunting/trapping for the zones has yet to be determined. The factors that would be considered in determining the order of zone eradication activities include: a) risk of failure over time because of vegetation recovery, b) length and separation of defendable perimeter, and c) evaluation of the island fox population viability in conducting certain activities, such as the fennel control burn. Continued monitoring of established pig-free zones would occur concurrently with the hunting efforts. Fence patrol for breaks and openings caused by pigs and weather would also be an ongoing task during this phase.

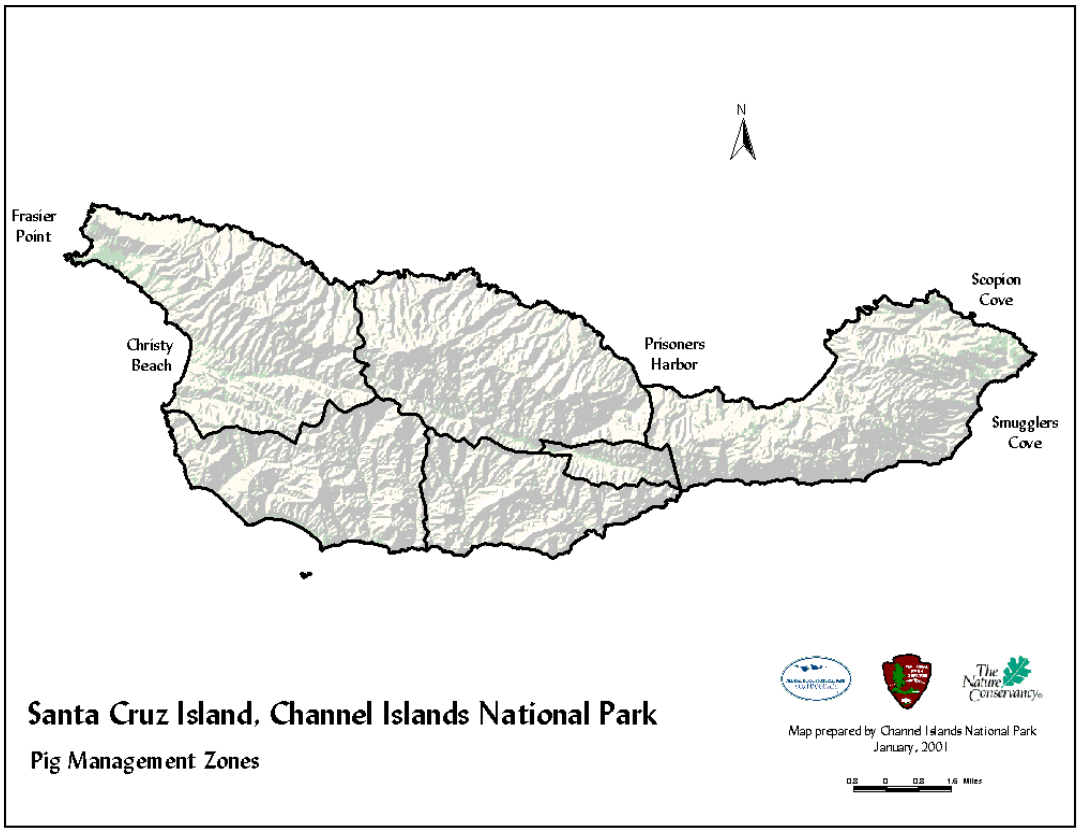
It is expected that the hunting team could achieve a nearly complete eradication status island-wide within a six-year period.

Phase IV. Final Hunting and Monitoring

Under the final phase of the program NPS, TNC, and hunting contractors (to a limited extent) would exhaustively search the island for remnant pigs and pig sign. Hunting teams would no longer be maintained on the island, but would be dispatched to areas if sign or animals were detected. A systematic protocol for detecting remnant feral pigs would be implemented for the island. Detection protocols would include, but not be limited to: systematic and random transects, indicator stations, baiting, aerial detection, and other pig detection techniques.

Island-wide remnant pig monitoring would continue for five years after elimination of what is thought to be the "last pig". Under the

Figure 4. Alternative Four Hunting Zones for Pig Eradication



direction of the park, long term ecological monitoring to assess ecosystem changes due to pig eradication would continue into the foreseeable future.

The decision to remove fence would only be made after a deliberate and collaborative process between TNC and NPS. Consultation with other pig eradication experts that have other similar projects (i.e. Catalina Island Conservancy and Hawaii Volcanoes NP) may be done. Decisions to rehabilitate areas disturbed as a result of the eradication activities would also be done under NPS and TNC collaboration.

Alternatives Considered But Dismissed from Detailed Study

Dismissed Alternatives and Techniques for Feral Pig Eradication

Live capture of feral pigs and relocation to the mainland

Feral swine, like all animals wild or domestic, are susceptible to a wide range of infectious and parasitic diseases. While some of these diseases are specific only to pigs, others are shared with other animals, including some that are shared with humans.

California is among the top states in the country for numbers of feral pigs. Currently, 52 of California's 58 counties are known to have feral pigs. As a statewide population, the number is great enough to cause substantial ecological impact, property damage, and further the spread of disease. As the numbers and distribution of feral pigs continue to increase, the contact between feral swine and domestic livestock, wild animals, and humans would also increase. This direct or indirect exposure to feral pigs brings with it a greater potential for transmission of both zoonotic (animal to human) and epizootic (animal to animal) diseases. To date, little information exists regarding diseases of feral swine, or the mechanisms or rates of transmission into domestic animals or humans.

Brucellosis and pseudorabies are the primary diseases carried by feral pigs nationwide and perhaps on Santa Cruz Island.

Brucellosis is a bacterial infectious disease of animals and humans that causes abortion and reproductive organ failure in the primary host, which in this case is the feral pig. In secondary hosts, such as humans, it can cause chronic flu-like symptoms, crippling arthritis, or meningitis. There is no cure for brucellosis for animals, while humans are treated with extremely high doses of antibiotics with the hope of clearing the infection. Brucellosis is transmitted via contact with fluids discharged from the infected animal (nasal mucous, semen, vaginal mucous, etc.).

Pseudorabies virus is a herpes simplex epizootic disease that largely affects domestic livestock, cats, and dogs. The disease is spread primarily by direct contact and ingestion of infected tissues or carcasses. The symptoms of pseudorabies virus vary widely among species, but can include anorexia, excessive salivation, spasms and convulsions, as well as "mad itch". Pseudorabies virus is almost always fatal.

Millions of dollars have been spent in a nation-wide effort to rid the United States of brucellosis and pseudorabies virus. Federal and state agencies responsible for these programs strongly forbid actions that may transmit these diseases. Therefore, both the State of California (1999) and the County of Ventura (1999) oppose transport of any live feral pigs from the island to the mainland. The California Department of Fish and Game stated "The Department would not approve a request to translocate wild pigs from Santa Cruz Island to the mainland. Our reasons for objecting to any plans to translocate wild pigs are two-fold: 1) potential spread of disease to other wild pigs or domestic swine, and 2) increasing the distribution and abundance of

an exotic species with great potential of causing damage."

The County of Ventura (Jenks 1999) has stated that it would be "irresponsible to risk the health and welfare" of mainland domestic livestock and pets by attempting to bring feral pigs from the island to the mainland.

The NPS concurs with this decision, opting to not risk transmission of potentially dangerous and fatal diseases to the mainland populations of domestic livestock, pets, and people.

Use of Poison

There are a number of toxicants which can be effective as part of an eradication program. However, each of the potential poisons could negatively affect non-target species. It would be very difficult to protect non-targets from incidental poisoning. Additionally, there are rare, endemic species, such as the island fox and spotted skunk, on Santa Cruz Island that could be impacted by the use of poisons. For these reasons, and because hunting can achieve the park goal without the secondary impact, poison would not be used as a tool in the eradication of feral pigs from Santa Cruz Island.

Use of Snares

Snares are an effective and inexpensive method of trapping pigs; however the use of snares on Santa Cruz Island could capture non-target animals such as the island fox or spotted skunk. Imperiling the island fox to this hazard is unacceptable to the NPS. Hunting and walk-in traps can achieve the park goal of eradication of pigs. Therefore, snares would not be used in this project.

Use of Contraceptives or Sterilization

Contraception and/or sterilization could be a relatively benign way of eliminating feral pigs from an area under controlled conditions. However, birth control technology is not yet adequate to achieve eradication, or even control, of feral pig populations. The NPS is not aware of a Food and Drug Administration (FDA) approved contraceptive or sterilant that could be used for feral pig eradication.

Contraceptives

Contraceptives are a tool that may work adequately in species with low reproductive rates or in animals that can be reliably and consistently treated with the contraceptive and booster at the required times and doses. Feral pigs do not meet either of these criteria.

Reproductive Rate: The primary reason why birth control is ineffective with pigs is their high reproductive rate. Sows can produce 2 litters of pigs per year and average 5.6 pigs/litter on Santa Cruz Island. Sows begin breeding in their first year. With such a high reproductive rate, even the smallest failure of the contraceptive (contraceptives can have failure rates as high as 20%) or failure to deliver the contraceptive and subsequent booster to every sow would result in production of a large new generation.

Consistent and Reliable Treatment: Treating every feral pig on Santa Cruz Island would be impossible. Considerations such as knowing which pigs have been treated, efficacy of the contraceptive on treated animals, the need for booster inoculations, accessing every pig in difficult terrain would all contribute to making the operation overly complex, expensive, and ultimately unreliable.

Sterilization

Sterilants in general cannot be used for this project because: 1) use of a sterilant would require injecting and marking each pig on the island; and 2) they are unproven for an eradication program.

Requires Injecting and Marking Each Pig on the Island: The logistics of delivering the sterilant to all pigs on the island comprises an insurmountable obstacle. Because pigs are nocturnal, secretive, and widespread, delivering injections to all pigs would be impossible, even if the injection was delivered remotely (by rifle).

The annual effort required would exceed the capabilities of NPS and TNC. And unless treated animals were marked, it would be impossible to distinguish treated pigs from untreated pigs.

Unproven for an Eradication Program: Sterilants are unproven for any mammal eradication program. Use of any sterilant on Santa Cruz Island feral pigs would be a waste of money and would not achieve the purpose of this plan, which is to eradicate feral pigs island-wide. Use of any sterilant would, at best, control pig populations, but cannot eradicate them. Mere control of the pig population is not acceptable, because pigs left on the island would continue to impact natural and cultural resources.

Public hunting on NPS property

Allowing hunting by members of the public, similar to hunting in National Forests or on certain state lands has been suggested as an inexpensive way to eradicate pigs while raising revenues for the park. The primary reasons why this tool cannot be used as part of the eradication program are: A) there is no legal authority that could allow public hunting to occur in CINP, and B) public hunting, regardless of guide or not, cannot achieve total eradication of feral pigs on the island, a stated goal of this plan.

Recreational hunting can achieve significant control or eradication of animals that have a relatively low reproductive potential. However, animals with high reproductive potentials, such as pigs and rabbits, are much more difficult to eradicate and require a very focused and sustained effort by skilled workers.

Through recreational hunting, the former owners of eastern Santa Cruz Island attempted, but failed, to control feral sheep numbers low enough to avoid extensive degradation of soils, vegetation and archeological sites on eastern Santa Cruz. Thousands of sheep remained on East Santa Cruz Island at the time of acquisition by NPS in spite of extensive sport hunting. Sheep have a much lower reproductive potential than pigs.

The decision by Channel Islands National Park not to use recreational hunting as a part of its plan to eradicate pigs does not preclude The Nature Conservancy from allowing public hunting on its property prior to the start of the eradication program. Extensive hunting by recreational hunters may make hunting associated with the eradication program more difficult because the pigs may become more reclusive with the increased hunting pressure.

Use of Swine Diseases

Diseases, such as hog cholera, can be very effective in the reduction of pig populations. Hog cholera was introduced to Santa Cruz Island in the 1950's. It is thought that this resulted in a reduction of pig numbers on Santa Cruz Island by 75% or more. A survey conducted in the late 1980's confirmed that there is no remnant hog cholera left within the population of feral pigs on Santa Cruz Island.

Hog cholera has been successfully eliminated from the United States and is now classified as a foreign pathogen and disease. As such, hog cholera is not permitted for use in any capacity in the United States.

This alternative was also rejected from further consideration because of the possibility of transmission of the pathogen to the domestic livestock, wild animals, or humans on the mainland or on the island.

Dismissed Alternatives for Fennel Control

Mechanical Fennel Control (Exclusive)

Mechanical control has been proposed as an alternative way of controlling fennel on the isthmus. Mechanical control would consist of mowing the fennel annually with the goal of preventing the fennel plants from producing seed during the growing season. The objective would be to continue a mowing program until the seed bank in the soil is depleted. It is

estimated that fennel seeds remain viable in the soil for at least 5-7 years.

Controlling fennel in this manner was rejected as a viable option for a number of reasons. First, because fennel is an indiscriminate seeder (sets seed from May through October) it would not be possible to conduct a single-pass mowing program and ensure that the fennel plants would not produce seed during the growing season. Second, it would be impossible, and possibly unsafe, to mow substantial amounts of the fennel given the difficult terrain. Third, mowing such a large area would require multiple passes by a tractor mower, which would cause significant soil disturbance. Lastly, although fennel generally reproduces by seed, it does have the ability to resprout from the crown of the plant's root system after mowing. So despite an aggressive effort to mow the fennel stand, the fennel would still have the ability to produce seeds later in the same season. However, until fennel control is achieved, mowing would still continue along roads and trails.

Mechanical Fennel Control (Hand Application of Herbicide)

Mechanical control of fennel would be done as described above e.g. tractor mowing. Following mowing, herbicide would be applied using backpack sprayers, ATV mounted spray units, and truck mounted slip-on spray units.

This method was rejected as a viable alternative because of concerns regarding efficiency, safety, and soil disturbance.

Efficiency: It is estimated that to apply herbicide to approximately 1,800 acres of fennel by these means would require at least a six-person crew working from May through September. Because seeds remain viable in the soil for at least 5-7 years, the spray crew would have to apply herbicide annually in multiple consecutive years. The cost of hiring such a crew (including vehicles, equipment, and herbicide), the limited housing availability on the island and transportation logistics makes this alternative too expensive and inefficient when compared to aerial broadcast application.

Safety: Although the crew would follow all state and federal safety measures, the crew would be required to handle herbicide frequently, increasing exposure and the chance for spills. In addition, the difficult terrain within the fennel patch would require the crews to operate mechanized equipment on uneven steep terrain. Much of the area would be in areas inaccessible to mechanized spray units. Such areas would require crewmembers to carry heavy backpack sprayers. Carrying heavy backpack spray units over steep, uneven terrain can be hazardous.

Disturbance: As mentioned previously, mowing would cause significant soil disturbance. In addition to the disturbance caused by mowing, 4-wheel drive pickups and ATV's would be used in accessible areas causing additional soil disturbance and soil compaction.

Burn Fennel (Hand Application of Herbicide – no aerial spraying)

This dismissed alternative would pre-treat the fennel with fire as outlined, then only use hand application of herbicide (i.e. exclude use of aerial herbicide application). Rationale for dismissing exclusive use of hand application of herbicide is given above.

Preferred Alternatives

This section provides a discussion regarding the "Environmentally" and "Agency" preferred alternative. The environmentally preferred alternative is the alternative that causes the least damage to the biological and physical environment. Identification of the agency-preferred alternative allows the public to

understand what actions the agency would like to implement.

The decision maker is under no obligation to choose either the "environmentally" or "agency' preferred alternatives. In many cases the "environmentally preferred" and "agency preferred" alternatives are the same, however, for this analysis the "agency" preferred alternative is different.

Environmentally Preferred Alternative

To be considered environmentally preferred the alternative would have to eliminate feral pig impacts island-wide. Without island-wide pig eradication significant natural and cultural resources impacts would be ongoing and would lead to a more degraded environment. Since Alternative One and Three allow pig impacts to continue, they cannot be considered "environmentally preferred".

In considering which alternative is the environmentally preferred among the remaining Alternatives (Two and Four), a comparison was made regarding duration and severity of effects associated with the implementation of each alternative. For this comparison it is assumed that these alternatives meet their objective within the predicted timeline (100% efficacy).

The activities associated with fence construction and fennel control are considered to have the severest short-term environmental impacts. Since fennel control is identical for these alternatives, comparing miles of fence construction would give an indication of which alternative would have the most severe environmental effects. Alternative Two does not require building fence to eradicate pigs from the island, whereas, Alternative Four would require approximately 45 miles of fence.

There are similarities in the effects on biological resources from implementation of Alternatives Two and Four; however, the duration of these effects is different among these alternatives. Comparing the duration of effects to biologic resources, Alternative Two would complete pig eradication in approximately three years with the bulk of biological effects occurring during these years. Alternative Four would have biological effects persisting for a minimum of six years, the length of time estimated to eradicate pigs from the island. However, when compared to Alternative Two and its two year eradication timeline, Alternative Four would have nearly 50% of the island mostly pig free within the same timeline. Post-eradication activities, such as fence removal, fence maintenance, and monitoring would extend disturbance-causing activities beyond the eradication activities.

Because Alternative Two has less physical disturbance (least severity) and would be completed in the shortest amount of time (least duration of biological effects) it is determined to be the "Environmentally Preferred Alternative." However, if both Alternatives meet the 100% eradication objective, the long-term (5+ years post-eradication) beneficial effects would be similar.

Agency Preferred Alternative

For reasons given in the efficacy discussion (*Issue 1: Likelihood of Success*) in Chapter Four, the agency preferred alternative is Alternative Four.

The efficacy discussion for Alternative Two points out concerns the agency has with regards to implementing a high intensity/short duration implementation strategy. The analysis concludes that if the Park was unable to implement such a strategy, for whatever reasons, the probability of success decreases.

The Park is more confident that the deliberate longer term eradication strategy identified in Alternative Four can be implemented more easily given the logistical and financial challenges of supporting a complex program on an offshore island.

Comparison of Alternatives

**See Table 3 below.

Table 3. Comparison of Alternatives

	Alternative One	Alternative Two	Alternative Three	Alternative Four
Pig Eradication Strategy	No Eradication Strategy would be implemented	Hunt all areas simultaneously until all pigs are eradicated	Create two pig zones: eradicate pigs in NPS zone; exclude pigs from selected resources on TNC property	Hunt and establish walk-in traps by zone until all pigs are eradicated
Fence construction (miles)	None	None	Minimum of 3 miles (NPS property boundary); 3-20 miles to protect sensitive resources on TNC property	~45
Duration of Project	0	Estimated 2 years of eradication, 5 years inspect and monitor	2 years of eradication on NPS lands; defend exclusion areas until mgmt strategy changes	6 years of eradication, 5 years inspect and monitor
Fennel Control	None	Prior to pig eradication - Burn Fennel in the fall; aerially spray with herbicide two consecutive springs	Same as Alt. 2	Same as Alt. 2
Likelihood of Success	None	High	Low	High